INTERNATIONAL STANDARD

**ISO 12142**

First edition
2001-11-15

# Electronic imaging — Media error monitoring and reporting techniques for verification of stored data on optical digital data disks

*Imagerie électronique — Méthodes de surveillance et d'établissement de compte rendu d'erreurs pour la vérification des données stockées sur des disques optiques numériques*



Reference number
ISO 12142:2001(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

# Contents

Page

## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 12142 was prepared by Technical Committee ISO/TC 171, *Document imaging applications*, Subcommittee SC 1, *Quality*.

Annexes A to D of this International Standard are for information only.

# Introduction

Data and records managers in many organizations are already using optical disk-based information systems for storing and retrieving large data sets and for storing valuable information. The optical disk drives that are part of these systems are designed with powerful, but not unlimited, error correction capabilities. If the level of errors in an optical digital data disk sector exceeds the error detection and correction mechanisms implemented in the optical disk drive controller, the sector cannot be corrected (data loss might occur). System managers would like to be able to use media error monitoring and reporting techniques to verify the information stored on optical digital data disks, both initially when the data is transferred to that media and periodically to monitor the status of their data. The Media Error Levels of correction taking place in the optical disk drive controller give an indication of the status of data saved on these optical digital data disks.

This International Standard documents two approaches of media error monitoring and reporting techniques to verify stored data on optical digital data disks:

— a high-level approach with functional commands;

— an implementation of a set of Small Computer System Interface-2 (SCSI-2) commands.

The high-level interface approach is independent of the host operating system (e.g. DOS, UNIX, OS/2, etc.) and the interface that communicates between the optical disk device and the host (e.g. SCSI-2, IPI, LAN, etc.). In addition, this high-level interface is media type and size independent. That is, it can be used with systems that use Write-Once-Read-Many (WORM), rewritable or partially read-only media, and with optical disk drives for different media sizes from 90 mm to 356 mm media. Standard information about media errors allows end users and system integrators to retrieve the same information even if their configurations consist of drives of different types, sizes, and manufacturers. This information can be retrieved using the same software, which can be integrated into the media error information utilities or device drivers.



The SCSI interface can be used instead of the high-level interface by using the selected set of SCSI-2 commands. This selected set of SCSI-2 commands allows system manufacturers to develop drive type and size independent data verification tools at the SCSI level through the use of media error monitoring and reporting techniques. The use of a selected standard set of commands and approaches for media error monitoring and reporting allows any implementor to use a common set of software tools that do not change from drive to drive.

The media error information that can be obtained using the high-level or SCSI-2 tools includes:

— a list of reallocated sectors;

— corrections above some Media Error Levels;

— warning above some Verify Media Error Levels;

— the total number of bytes in error, the number of bytes in error per sector, and the maximum number of bytes in error in any sector codeword;

— the uncorrected or corrected sector content;

— errors encountered when reading header information, such as the sector address, sector marks, and synchronization signals;

— the maximum length of contiguous defective bytes.

By acquiring optical disk-based information systems that comply with this International Standard, system managers will be able to access media error information at both a functional (higher) level and an interface level for optical

disk drives that implement ISO/IEC 9316. These tools facilitate a better understanding of the status of information stored on optical digital data disks. The tools provide for design of more efficient media error monitoring and reporting techniques, and data verification and recopying policies for transferring recorded data to similar or different media in a timely and economic manner.

These media error monitoring and reporting techniques also allow system managers to obtain media error information either in quasi-real time or during off-line operations. These techniques provide data recovery and media error monitoring tools with different levels of sophistication. Information on media errors can be obtained, which will enable the highlighting of trends on particular selected disks or in their entire data sets. Decisions on frequency of use of these tools and the level of sophistication selected are not part of this International Standard.

# Electronic imaging — Media error monitoring and reporting techniques for verification of stored data on optical digital data disks

## 1 Scope

This International Standard specifies two techniques for media error monitoring and reporting for the verification of data stored on optical digital data disks:

— high-level, which uses a set of functional commands;

— SCSI-2 level, which uses a set of SCSI-2 commands.

It specifies two media error monitoring and reporting levels:

— system level, which uses a set of functional commands that can be used by the operating system, application software, and remote users;

— optical disk device level, which uses a set of SCSI-2 commands that can be used by the device driver or a device application programme.



Compliance to the requirements of this International Standard is specified in clause 4.

This International Standard applies to both rewritable and read only optical disk media.

Part of the information in this International Standard may be useful for CD-ROM subsystems, but implementations for that technology are beyond the scope of this International Standard.

## 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO/IEC 9316:1995, *Information technology — Small Computer System Interface-2*

ISO 12651:1999, *Electronic imaging — Vocabulary*

## 3 Terms and definitions

For the purposes of this International Standard, the terms and definitions given in ISO/IEC 9316, ISO 12651 and the following apply.

**3.1**
**band**
specified number of contiguous tracks

NOTE It is a useful notation for referencing disk regions and plotting physically descriptive media error results.

**3.2**
**byte error rate**
**BER**
total number of bytes in error in a given sample divided by the sample size

**3.3**
**constant angular velocity**
recording method in which the number of clock periods per revolution is constant, independent of radius

NOTE This method implies that the amount of data per track is independent of radial position.

**3.4**
**continuous–servo media**
media on which the servo information for tracking is continuously available on adjacent grooves

**3.5**
**data field**
user data, defect management pointers (DMP), cyclic redundancy check (CRC), and error correction code (ECC) bytes of a recorded sector



**3.6**
**format**
arrangement or layout of the data on the disk



**3.7**
**initiator**
SCSI device that requests an I/O process to be performed by another SCSI device (a target)

**3.8**
**interleaving**
process of allocating the physical sequence of units of data in order to render the data more immune to burst errors

**3.9**
**native format**
error correction code (ECC) data and control bytes, and stripping sync bytes

**3.10**
**Reed–Solomon codes**
error correction code particularly suited to the correction of errors that occur in bursts or are strongly correlated

**3.11**
**sampled–servo media**
media on which the servo information for focusing and tracking, along with clock information, is obtained by means of periodic sampling of information on the optical disk

**3.12**
**target**
SCSI device that performs an operation requested by the initiator

**3.13**
**verification of data**
verification of the integrity and status of data

## 4 Requirements

This International Standard specifies the following two levels of compliance:

— the BASIC level which uses a minimal set of functions and commands;

— the EXTENDED level which uses all of the functions and commands in the BASIC level plus a MEDIA ERROR LOG and user-set optical disk device programmable Media Error Levels and Verify Media Error Levels. The EXTENDED level also allows users to interrogate the optical disk system (using the functional commands) or the optical disk device (using a set of SCSI-2 commands) about the current setting of the optical disk device set Media Error Levels and set Verify Media Error Levels.

Statements of compliance to the requirements of this International Standard shall state the level of compliance used, BASIC or EXTENDED, at the system level interface and device level.

An optical disk-based information system is in accordance with this International Standard when it meets all the requirements specified in clause 7 (for BASIC or EXTENDED compliance).

An optical disk device that conforms to ISO/IEC 9316 is in accordance with this International Standard when it meets all the requirements specified in clause 8 (for BASIC or EXTENDED compliance).

Table 1 summarizes the BASIC and EXTENDED levels of compliance at the optical disk-based system level (system level). Table 2 summarizes the BASIC and EXTENDED levels of compliance at the optical disk device level (application of SCSI-2 commands for optical disk devices).



**Table 1 — System level compliance**

| Functional level for optical disk-based subsystems: | Level of compliance | |
|---|---|---|
| **Function description** | **BASIC** | **EXTENDED** |
| Define media error recovery procedures (DMERP) | Yes | Yes |
| Read defect data list (RDDL) | Yes | Yes |
| Read media error data (RDMED) | Yes | Yes |
| Read log data (RLD) – Media error log and current Media Error Levels | No | Yes |
| Set Media Error Levels (SMEL) | No | Yes |
| Set Verify Media Error Levels (SVMEL) | No | Yes |

**Table 2 — Conformance at the optical disk device level**

| Application of SCSI-2 commands for optical disk devices | Level of compliance | |
|---|---|---|
| | BASIC | EXTENDED |
| The FORMAT UNIT command | Yes | Yes |
| The LOG SELECT command and the following pages: | No | Yes |
| — The media error log (MEL) page | No | Yes |
| — The clear MEL page | No | Yes |
| The LOG SENSE command and the following pages: | No | Yes |
| — The MEL page | No | Yes |
| — The clear MEL page | No | Yes |
| The MODE SELECT command and the following pages: | No | Yes |
| — The read-write error recovery page for optical disk devices | No | Yes |
| — The verify recovery page for optical disk devices | No | Yes |
| The MODE SENSE command and the following pages: | No | Yes |
| — The read-write error recovery page for optical disk devices | No | Yes |
| — The verify recovery page for optical disk devices | No | Yes |
| The READ DEFECT DATA command and the PDL, SDL, and WDL | Yes | Yes |
| The READ LONG command | Yes | Yes |
| The REQUEST SENSE command, the sense keys 01h or 03h, and the related ASC or ASCQs | Yes | Yes |
| The VERIFY command | Yes | Yes |
| The WRITE AND VERIFY command | Yes | Yes |



## 5 Conventions

This International Standard follows the conventions given in 4.2 of ISO/IEC 9316:1995. For the purpose of identification, the parameters “Media Error Levels” and “Verify Media Error Levels” used in this International Standard are shown with first upper case letters. The following conventions from ISO/IEC 9316 are reproduced:

Numbers that are not immediately followed by lower-case b or h are decimal values.

Numbers immediately followed by lower-case b (xxb) are binary values.

Numbers immediately followed by lower case h (xxh) are hexadecimal values.

## 6 Capabilities of media error monitoring techniques

The high-level interface functions specified in clause 7 and the application of SCSI-2 commands specified in clause 8 provide two approaches for retrieving the following information about a disk:

— consumption of spare sectors (physical address of each sector reallocated and of spare sectors still available in the reallocation table, when a reallocation table exists, or a list of sector addresses of the replaced sector and its replacement);

— corrections that exceeded Media Error Levels;

— warning on Verify Media Error Levels;

— the total number of bytes in error, the number of bytes in error per sector, and the maximum number of bytes in error in any codeword;

— the uncorrected or corrected sector content;

— errors encountered when reading header information (bad IDs, sector missing marks, data syncs, and resync marks);

— maximum length of contiguous defective bytes.

Media Error Levels and Verify Media Error Levels can be set.

# 7 High-level techniques

## 7.1 Introduction

The purpose of this clause is to provide high-level (a set of functional commands) media error monitoring and reporting techniques for verifying stored data on optical digital data disks. By implementing this International Standard, the following are enabled:

— set Media Error Levels to reallocate sectors whenever one of the Media Error Levels is exceeded;

— obtain the value of the Media Error Levels;



— set Verify Media Error Levels to obtain early warning information on the status of the data when one of the Verify Media Error Levels is exceeded;

— obtain the values of the Verify Media Error Levels;



— obtain information about all the reallocated sectors and a defect list of initial media defects;

— retrieve a media error log with information about the media error activity detected by the drive;

— obtain the corrected sector content or the uncorrected sector content including user data bytes and error correction code (ECC) bytes.

The high-level interface approach is independent of the host operating system (e.g. DOS, UNIX, OS/2, etc.) and the interface between the optical disk device and the host (e.g. SCSI-2, IPI, LAN, etc.). In addition, this high-level interface is media type and size independent. That is, it can be used with systems that use WORM, rewritable or partially read-only media, and optical disk devices for different media sizes (e.g. 90 mm to 356 mm).

Standard formats for disk errors will allow the retrieval of the same information from configurations consisting of drives of different types, sizes, and manufacturers by using the same routines integrated into the media error information utilities or device drivers.

## 7.2 Functional commands

The following functional, or high-level (host), commands shall be used for verifying the data.

### 7.2.1 Generic command description

The following command syntax is used in this International Standard:

Command name [parameter 1] [parameter 2] [parameter 3] …… [parameter *n*]

At least one parameter shall be included with the command name. A parameter that can be set ON or OFF is indicated as:

⌈Parameter ON⌉

⌊ OFF⌋

### 7.2.2 Define Media Error Recovery Procedures (DMERP)

The DMERP command shall be used to define to the optical disk device the following error recovery procedures:

— media error reporting;

— media error data transfer that shall be executed.



The default for an unspecified parameter shall be OFF.

**DMERP** ⌈WR ON⌉ ⌈RE ON⌉ ⌈RRE ON⌉

⌊ OFF⌋ ⌊ OFF⌋ ⌊ OFF⌋



WR: Sector Reallocation on Write Error

— ON: Enables the device error recovery procedures to automatically reallocate a sector(s) to a spare sector area on the disk whenever the optical disk device encounters an error level that exceeds the set Media Error Levels during writing operations;

— OFF: Disables the optical disk device error recovery procedures from automatically reallocating a sector(s) whenever the optical disk drive encounters an error level that exceeds the set Media Error Levels during writing operations.

RE: Sector Reallocation on Read Error

— ON: Enables the optical disk device error recovery procedures to automatically reallocate a sector(s) to a spare sector area on the disk, whenever the optical disk device encounters an error level that exceeds the set Media Error Levels when reading a sector(s);

— OFF: Disables the device error recovery procedures from automatically reallocating a sector(s) whenever the optical disk device encounters an error level that exceeds the set Media Error Levels when reading a sector(s).

RRE: Report Recovered Errors

— ON: The optical disk device shall report recovered errors to the host computer;

— OFF: The optical disk device shall not report recovered errors to the host computer.

### 7.2.3 Read Defect Data List (RDDL)

The RDDL command shall be used to read the defect data list from the optical disk device. The defect data list is shown in Table 3.

**Table 3 — Defect data list**

| Byte | Description |
|---|---|
| 1 | Number of entries in the list (MSB) |
| 2 | Number of entries in the list (LSB) |
| 3 | Defective sector track number (MSB) |
| 4 | Defective sector track number |
| 5 | Defective sector track number (LSB) |
| 6 | Defective sector number |
| $n$ – 3 | Defective sector track number (MSB) |
| $n$ – 2 | Defective sector track number |
| $n$ – 1 | Defective sector track number (LSB) |
| $n$ | Defective sector number |



**RDDL** [List Size]

List Size specifies, in hexadecimal, the number of bytes to be transferred. The defect list data shall be returned to the host in the format shown in Table 3. If List Size is set to zero, no data shall be transferred. Bytes shall be transferred in hexadecimal values.



### 7.2.4 Read Media Error Data (RDMED)

The RDMED command shall be used to request the optical disk device to transfer the content of a sector to the host computer. The data transferred to the host shall include the following:

— the user data bytes;

— the ECC bytes;

— the defect management pointers (DMP) bytes;

— any other bytes that are part of the sector data field and can be corrected by the ECC.

These bytes shall be sent to the host in the same order as they occur on the medium, according to any existing related medium International Standard (e.g. for ISO/IEC 10089, format A media, the type of bytes shall be Data, DMP, CRC, and ECC. See ISO/IEC 10089:1991, annex G). The bytes shall be expressed in hexadecimal values. The most recent data written to the addressed sector shall be read from the medium and returned.

**RDMED** ⌈ADDR BXFER ⌈CORR ON⌉⌉

⌊ ⌊ OFF⌋⌋